iSCSI STORAGE ARRAYS: EMAIL AND DATABASE PERFORMANCE

Dell™ PowerVault™ MD3220i delivers 114% better email performance and 221% better database performance

versus

on representative test workloads

Dell PowerVault MD3000i

OUR FINDINGS

The responsiveness and capacity of a company's email and database infrastructure rely heavily on the underlying storage subsystem. In Principled Technologies' tests in our labs, the new Dell PowerVault MD3220i iSCSI SAN array exceeded the email performance of the older Dell PowerVault MD3000i array by 114.9 percent and the database performance by 221.4 percent. Our results show that upgrading to the Dell PowerVault MD3220i can boost a company's email and database performance and let it support significantly more users.

OUR PROCESS

To gauge how well each storage array would handle email and database requests, we used the Iometer benchmarking tool to run Microsoft Exchange Server 2007 and Microsoft SQL Server Decision Support Systems (DSS) workloads. These workloads simulate the email activity of an increasing number of users and the database activity of a Decision Support System. We used the maximum numbers of drives supported by each system, 96 drives for the Dell PowerVault MD3220i and 45 drives for the Dell PowerVault MD3000i, and we configured multiple I/O paths to each array.

MAY 2010

A PRINCIPLED TECHNOLOGIES TEST REPORT

Commissioned by Dell Inc.

PROJECT OVERVIEW

We tested the following storage devices:

- Dell PowerVault MD3220i (1Gb iSCSI host interfaces with 6Gb SAS backend)
- Dell PowerVault MD3000i (1Gb iSCSI host interfaces with 3Gb SAS backend)

The goal was to determine which solution provided better performance and throughput for random input/output (I/O) workloads such as Microsoft Exchange 2007 and Microsoft SQL Server DSS. We represent performance in terms of total input/output operations per second (IOPS) and total throughput.

We configured both the Dell PowerVault MD3220i and the Dell PowerVault MD3000i to use a comparable proportion of their usable capacity. We created identical test beds for both devices that consisted of two Dell PowerEdge™ R710 rack servers to generate the workload on the arrays. Both arrays use Internet Small Computer System Interface (iSCSI) technology for their connection to the servers. The Dell PowerVault MD3220i supports 6Gbps drive technology, while the Dell PowerVault MD3000i supports 3Gbps drive technology.

We ran the tests three times to ensure repeatability, and report the results from the run that produced the median total IOPS.

WORKLOAD

Iometer performs I/O operations on a server in order to stress the disk-subsystem, and then records the performance of and stress created by these I/O operations. Iometer can create and measure workloads on a single system or on networked systems. We used Iometer version 2006.07.27 on two Dell PowerEdge R710 servers to simulate a Microsoft Exchange Server 2007 workload and a Microsoft SQL Server DSS workload on the storage arrays. We present the number of outstanding I/Os and other specific settings we used during testing in Appendix A.

SYSTEM COMPARISON

Figure 1 shows a side-by-side comparison of the key hardware differences between the storage arrays. Appendix A presents detailed system information.

	Dell PowerVault MD3220i	Dell PowerVault MD3000i
		
Arrays	Dell PowerVault MD3220i	Dell PowerVault MD3000i
Disks	24x 146GB SAS 15k 2.5”, 72x 73GB SAS 15k (96 total)	13x 146GB SAS 15k 3.5”, 32x 73GB SAS 15k (45 total)
Disk layout	We created eight 12-disk RAID groups and used one volume on each RAID group for the Iometer workloads.	We created eleven 4-disk RAID groups and used one volume on each RAID group for the Iometer workloads.
Formatted storage capacity	4,078 GB	1,903 GB
Connection	iSCSI	iSCSI
Multi-pathing	Yes	Yes
RAID technology	RAID 10	RAID 10

Figure 1: Storage system configuration information.

WHAT WE FOUND

Figure 2 shows the Exchange Server 2007 total IOPS the two storage arrays achieved. As Figure 2 shows, the Dell PowerVault MD3220i achieved 18,968 total IOPS, while the Dell PowerVault MD3000i achieved only 8,826 total IOPS. The Dell PowerVault MD3220i achieved 114.9 percent greater total IOPS than did the Dell PowerVault MD3000i.

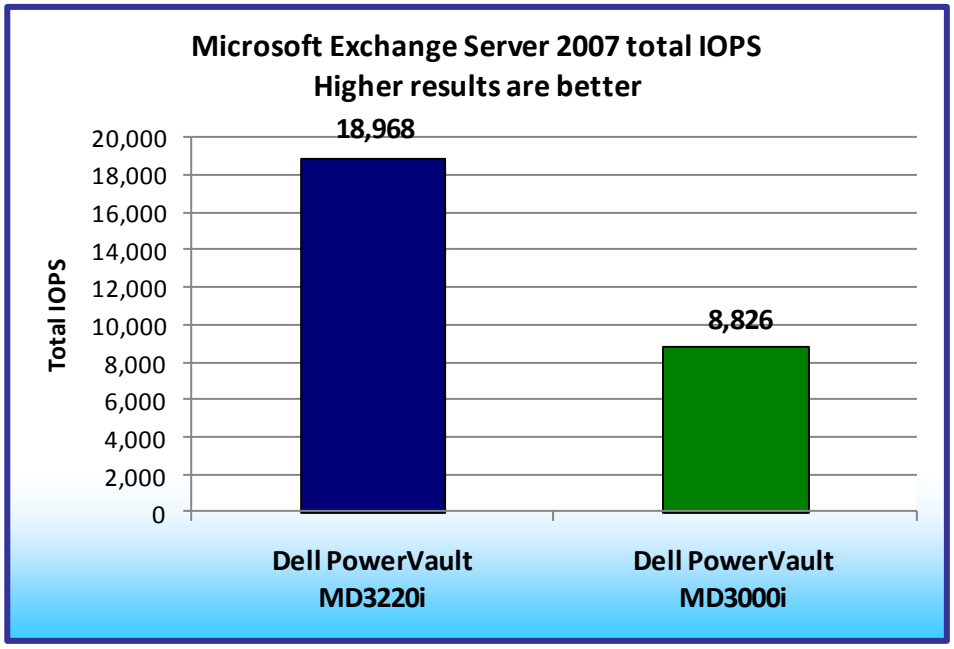

Figure 2: Exchange Server 2007 total IOPS results for the storage arrays during the Iometer test.

Figure 3 shows the Exchange Server 2007 throughput the two storage arrays achieved. The Dell PowerVault MD3220i achieved 148.2 MB/s, while the Dell PowerVault MD3000i achieved 69.0 MB/s. The Dell PowerVault MD3220i achieved 114.9 percent greater throughput than did the Dell PowerVault MD3000i.

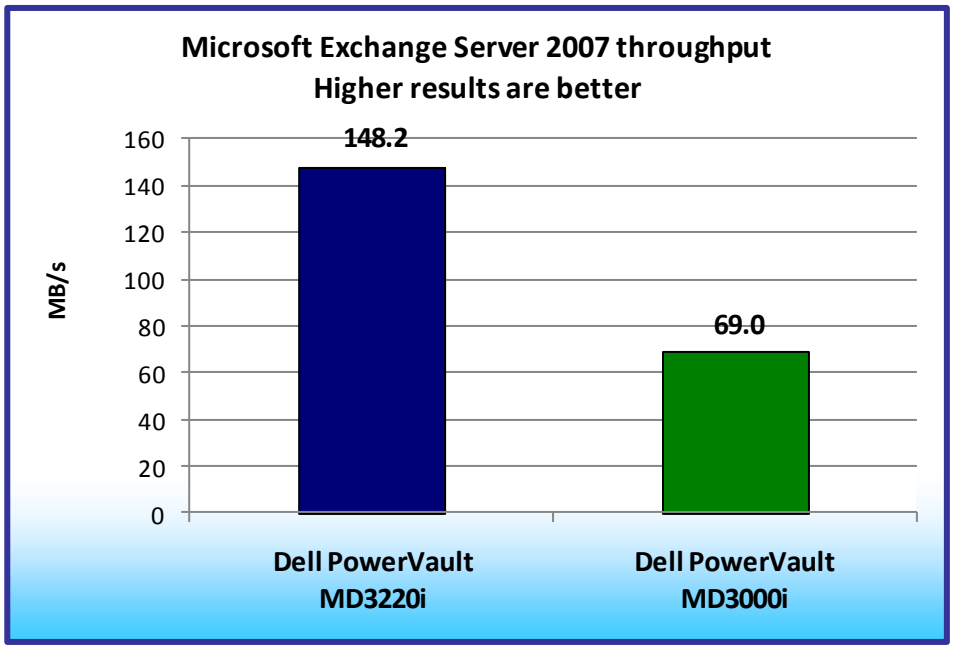

Figure 3: Exchange Server 2007 throughput results for the storage arrays during the Iometer test.

Figure 4 shows the SQL Server DSS throughput the two storage arrays achieved. As Figure 4 shows, the Dell PowerVault MD3220i achieved 864 MB/s, while the Dell PowerVault MD3000i achieved only 269 MB/s. The Dell PowerVault MD3220i achieved 221.4 percent greater throughput than did the Dell PowerVault MD3000i.

We report the median of the three runs. Appendix B provides complete results.

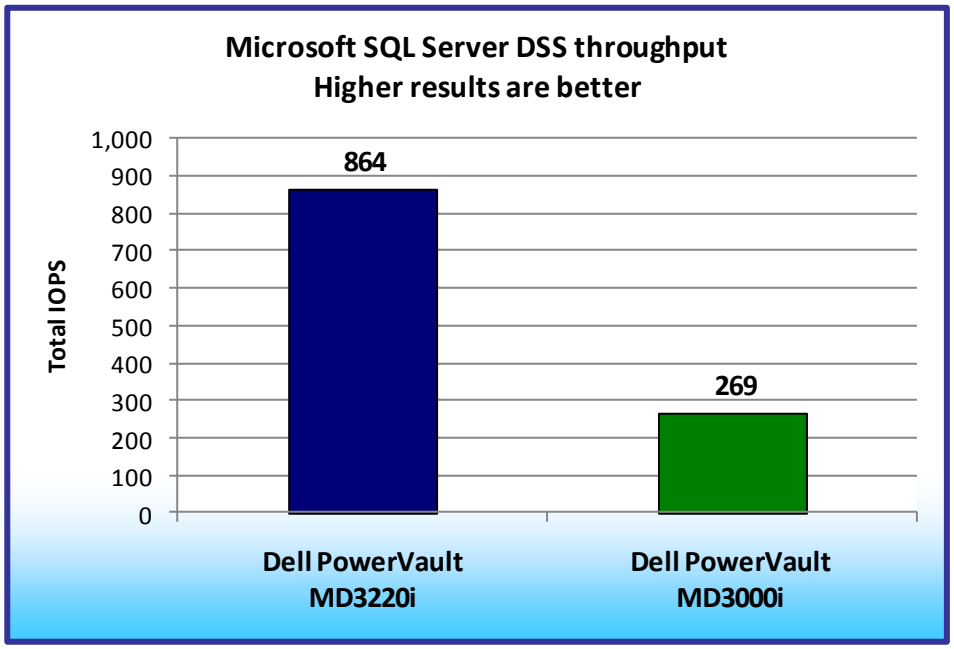

Figure 4: SQL Server DSS throughput results for the storage arrays during the Iometer test.

HOW WE TESTED

We created an Iometer workload that closely mirrors the disk activity of a server running Microsoft Exchange Server 2007 and another Iometer workload that simulates the disk activity of a server running Microsoft SQL Server with a DSS-type database.

We configured the Iometer Dynamo to run on two Dell PowerEdge R710 servers for each storage array and used one of these servers to run the Iometer application. We set Iometer to run for a total of 5 minutes with a 60-second ramp-up time for each run. We chose an amount of outstanding I/Os for each access specification to ensure that the storage arrays queued a sufficient amount of I/Os to provide the maximum IOPS possible.

We gathered the following results from the Iometer result files:

- Exchange Server 2007 IOPS
- Exchange Server 2007 MB/s
- SQL Server DSS IOPS
- SQL Server DSS MB/s

The results we report in Figures 2 and 3 are from the run that produced the median total IOPS.

Appendix C provides details of our test environment. Appendix D provides configuration details of our test server. Appendix E details the testing procedures we followed.

APPENDIX A – STORAGE CONFIGURATION AND SETUP

This appendix includes the Iometer parameters we used to simulate the Microsoft Exchange Server 2007 and Microsoft SQL Server DSS workloads and the steps we took to configure the arrays.

Simulated Exchange 2007 configuration

We defined the simulated Exchange 2007 workload using the following parameters:

- 8K transfer request size
- 67% reads, 33% writes
- 100% random, 0% sequential
- 8K sector boundaries
- 100% seek range
- 60 outstanding I/Os per target
- 1 worker per target

Simulated SQL Server DSS configuration

We defined the simulated SQL Server DSS workload using the following parameters:

- 1MB transfer request size
- 100% reads, 0% writes
- 100% random, 0% sequential
- 1MB sector boundaries
- 100% seek range
- 4 outstanding I/Os per target
- 1 worker per target

Figure 5 shows the primary storage hardware, Figure 6 shows the primary storage software on the host server, and Figure 7 shows the primary storage disk configuration.

Primary storage hardware

System	Dell PowerVault MD3220i	Dell PowerVault MD3000i
Total number of disks tested in solution	96	45 (44 active)
Storage connectivity (Fibre Channel, SAS, SATA, iSCSI)	iSCSI	iSCSI
Storage model and OS/firmware revision	Dell PowerVault MD3220i Firmware 97.70.03.62	Dell PowerVault MD3000i Firmware 07.35.31.60
Storage memory	4 GB (2 GB per controller)	1 GB (512 MB per controller)
Number of storage controllers	2	2
Number of storage ports	8	4

Figure 5: Primary storage hardware.

Primary storage software on host server

System	Dell PowerVault MD3220i	Dell PowerVault MD3000i
Server HBA/NIC driver	Broadcom BCM5709C NetXtreme II 5.0.15.0	Broadcom BCM5709C NetXtreme II 5.0.15.0
TCP chimney	Enabled	Enabled
Multi-pathing	Yes	Yes
Host OS	Windows Server 2008 SP2 x64	Windows Server 2008 SP2 x64
Max transfer length	1,024K	1,024K

Figure 6: Primary storage software on host server.

Primary storage disk configuration

System	Dell PowerVault MD3220i	Dell PowerVault MD3000i
Disk type and speed	24x 146GB SAS 15k 2.5", 72x 73GB SAS 15k 2.5" (96 total)	12x 146GB SAS 15k 3.5", 36x 73GB SAS 15k 3.5" (45 total)
Database LUN size (GB)	408 and 816	136 and 272
Raw capacity per disk (GB)	73 and 146	73 and 146
Number of physical disks in test	96	44
Total raw storage capacity (GB)	8,760	4,380
Raid level	RAID 10	RAID 10
Total formatted capacity (GB) (1GB=2^30 bytes)	4,078	1,903
Segment size	512K	512K
Cache settings	Read Cache Disabled, Write Cache Disabled	Read Cache Enabled, Write Cache enabled (Default)

Figure 7: Primary storage disk configuration.

APPENDIX B – TEST RESULTS

Figure 8 provides test results for the storage arrays, as well as information about the simulated Exchange 2007 configuration that defines the test workload. We ran the Iometer test three times for each storage array, and then determined the median. Note that the throughput and IOPS are the same for SQL Server DSS testing because the workload is 1 MB (1,024 KB) (whereas the Exchange workload is only 8 KB). The formula for MB/s is IOPS x operation size (in this case 1,024 KB or 8KB)/1,024 KB.

System	Dell PowerVault MD3220i	Dell PowerVault MD3000i
Exchange Server 2007 (higher is better)		
Run 1 IOPS	18,866.671	8,793.715
Run 1 MB/s	147.396	68.701
Run 2 IOPS	18,967.600	8,826.391
Run 2 MB/s	148.184	68.956
Run 3 IOPS	18,981.925	8,836.533
Run 3 MB/s	148.296	69.035
Median IOPS	**18,967.600**	**8,826.391**
Median MB/s	**148.184**	**68.956**
SQL Server DSS (higher is better)		
Run 1 IOPS	864.118	268.870
Run 1 MB/s	864.118	268.870
Run 2 IOPS	864.593	268.607
Run 2 MB/s	864.593	268.607
Run 3 IOPS	864.004	269.545
Run 3 MB/s	864.004	269.545
Median IOPS	**864.118**	**268.870**
Median MB/s	**864.118**	**268.870**

Figure 8: Iometer performance test results for the storage arrays.

APPENDIX C – TEST ENVIRONMENT

We created a test bed in a climate-controlled room for each storage system. Each test bed included the following components:

- Microsoft Exchange Server
  - Two Dell PowerEdge R710 servers installed with the following software:
    - Microsoft Windows Server® 2008 SP2 x64
    - Iometer 2006.07.27
- Switch
  - One Dell PowerConnect™ 5448 switch
    - Cat6e cables used
- Storage systems under test
  - One Dell PowerVault MD3220i array
    - Three Dell PowerVault MD1220 disk enclosures attached
  - One Dell PowerVault MD3000i Array
    - Two Dell PowerVault MD1000 disk enclosures attached

Figure 9 provides highlights of the Dell PowerEdge R710 server configuration. Figure 10 in Appendix D provides complete configuration details.

Dell PowerEdge R710 rack server	
Processors	Two quad-core Intel® Xeon® Processor X5570s at 2.93 GHz
Memory	48 GB, 6 x 8 GB, 1,333 MHz
Internal disk	One 146GB, 15K RPM Seagate ST9146852SS SATA drive
Network	Integrated Quad Port Broadcom BCM5709C
Operating system	Microsoft Windows Server 2008 SP2 x64
Test software	Iometer 2006.07.27

Figure 9: Dell PowerEdge R710 server configuration highlights.

APPENDIX D – SERVER CONFIGURATION INFORMATION

Figure 10 provides detailed configuration information about the test server.

Server	Dell PowerEdge R710
General dimension information	
Height (inches)	3.50
Width (inches)	17.50
Depth (inches)	27.00
U size in server rack (U)	2
Power supplies	
Total number	1
Wattage of each (W)	570
Cooling fans	
Total number	5
Dimensions (h x w) of each	2.50" x 2.50"
Voltage (V)	12
Amps (A)	1.60
General processor setup	
Number of processor packages	2
Number of cores per processor package	4
Number of hardware threads per core	2
CPU	
Vendor	Intel
Name	Xeon X5570
Stepping	D0
Socket type	LGA1366
Core frequency (GHz)	2.93
L1 cache	4 x 32 KB + 32 KB
L2 cache	4 x 256 KB
L3 cache (MB)	8
Platform	
Vendor and model number	Dell PowerEdge R710
Motherboard model number	0M233H
Motherboard revision number	13
BIOS name and version	Dell 1.3.6 (12/14/2009)
BIOS settings	Default
Memory modules	
Total RAM in system (GB)	48
Vendor and model number	Samsung M393B1K70BH1-CH9
Type	PC3-10600R
Speed (MHz)	1,333
Speed in the system currently running @ (MHz)	1,333

Server	Dell PowerEdge R710
Timing/latency (tCL-tRCD-iRP-tRASmin)	9-9-9-9
Size (GB)	8
Number of RAM modules	6
Chip organization	Double-sided
Hard disk	
Vendor and model number	Seagate ST9146852SS
Number of disks in system	1
Size (GB)	146
Buffer size (MB)	16
RPM	15,000
Type	SAS
Network card/subsystem	
Vendor and model number	Broadcom BCM5709C
Type	Integrated

Figure 10: Detailed system configuration information for the server we used for testing.

APPENDIX E – TEST PROCEDURES

We set up our test environment and installed Microsoft Windows Server 2008 x64 Enterprise Edition Service Pack 2 on the test server.

Installing Microsoft Windows Server 2008 x64 Enterprise Edition Service Pack 2 on the server

We began our testing by installing a fresh copy of Microsoft Windows Server 2008 x64 Enterprise Edition Service Pack 2 on the server. We followed this process for each installation:

1. Assign a computer name of *server*.
2. For the licensing mode, use the default setting of five concurrent connections.
3. Enter a password for the administrator logon.
4. Select Eastern Time Zone.
5. Use typical settings for the Network installation.
6. Turn Windows Firewall off.

Note: We used default BIOS settings on the server. We installed all recommended Windows Updates through 3/4/2010.

Disabling Windows Firewall

1. Click Start→Administrative Tools→Windows Firewall and Advanced Security.
2. Under the Overview heading, click Windows Firewall Properties.
3. Click the dropdown menu beside Firewall state, and select Off.
4. Click the Private Profile tab.
5. Click the dropdown menu beside Firewall state, and select Off.
6. Click the Public Profile tab.
7. Click the dropdown menu beside Firewall state, and select Off.
8. Click OK to close the Properties window.
9. Close the Windows Firewall with Advanced Security window.

Installing and configuring Iometer

1. Download the Iometer package from www.iometer.org.
2. Double-click the installer, and click Next at the welcome window.
3. At the License Agreement window, click I Agree.
4. At the Choose Components window, leave the defaults selected, and click Next.
5. At the Choose Install Location window, change the Destination Folder to C:\Iometer 2006.07.27, and click Install.

Setting up the individual Iometer workloads

We used the following settings for each test:

1. Open Iometer.exe.
2. For each access specification:
    a. Create the access specification to match the configurations in Appendix A.
    b. Verify that the access specification has the following additional settings:

i. Under Burstiness, set Transfer Delay to 0ms and set Burst Length to 1 I/O.
ii. Under Align I/Os, select 8K or 1MB depending on the specification.
iii. Under Reply Size, select No Reply.

c. Under Topology, select the computer name, and click the Start a New Disk Worker on Selected Manager button until you have one worker assigned to each target volume.
d. Under Disk Targets, set the # of Outstanding I/Os according to the corresponding value shown in Appendix A.
e. Set the disk size to 0 sectors (full seek range).
f. Under Results Display, make sure that Iometer has selected Start of Test.
g. Under Test Setup, set the Run Time to 4 minutes and the Ramp Up Time to 60 seconds.

3. Exit Iometer.

Running the Iometer test

1. Reboot the system.
2. After logging in, open a command prompt.
3. Type `cd c:\Iometer 2006.07.27` and press Enter.
4. Type `run.bat`
5. Wait 5 minutes.
6. Press Enter.
7. After all access specifications are finished running, copy the result files from the server.
8. Repeat steps 1 through 7 two more times, for a total of three runs.

ABOUT PRINCIPLED TECHNOLOGIES

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We provide industry-leading technology assessment and fact-based marketing services. We bring to every assignment extensive experience with and expertise in all aspects of technology testing and analysis, from researching new technologies, to developing new methodologies, to testing with existing and new tools.

When the assessment is complete, we know how to present the results to a broad range of target audiences. We provide our clients with the materials they need, from market-focused data to use in their own collateral to custom sales aids, such as test reports, performance assessments, and white papers. Every document reflects the results of our trusted independent analysis.

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Our founders, Mark L. Van Name and Bill Catchings, have worked together in technology assessment for over 20 years. As journalists, they published over a thousand articles on a wide array of technology subjects. They created and led the Ziff-Davis Benchmark Operation, which developed such industry-standard benchmarks as Ziff Davis Media's Winstone and WebBench. They founded and led eTesting Labs, and after the acquisition of that company by Lionbridge Technologies were the head and CTO of VeriTest.